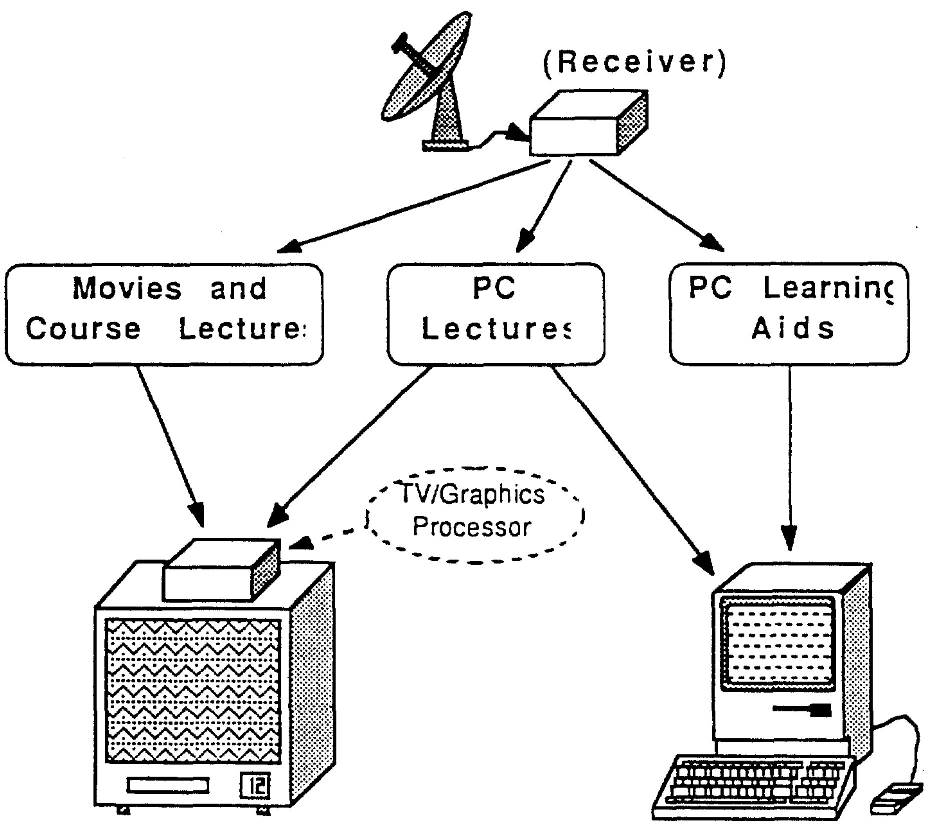
Services to be provided

Three main types of services will be provided by the YES Network:

- **Television movies and course lectures**
- **Personal computer course lectures**
- **Personal computer learning aids**



Television movies and course lectures will be displayed on a standard NTSC television set. The cost of transmitting course lectures is much less than that of movies due to the more limited motion needs and the consequent higher achievable transmission compression. This service will be comparable to that presently available for televised course lectures. However, it will be universally available and the cost will be much less. Also, multi-channel services of various categories will be provided simultaneously.

Personal computer course lectures will be displayed directly on a classroom or home computer equipped with a special interface card. A separate audio output will be provided to an external speaker. The graphics capabilities of the personal computer will be used to provide dynamic images consisting of progressive slides, an electronic blackboard, animated displays, or a combination thereof. Alternatively, a graphics interface unit will allow this service to be viewed on a standard NTSC television set.

Extremely sophisticated video presentations can be transmitted very economically in this manner. Several software packages are available today for generation of presentations on personal computers. Many instructors are presently using these techniques to generate and present their courses. For example, the "Vivarium" project in Los Angeles (LA Open Magnet School, Apple Computer, and MIT Media Lab) is making extensive use of these techniques.

Personal computer learning aids will also be available. For example:

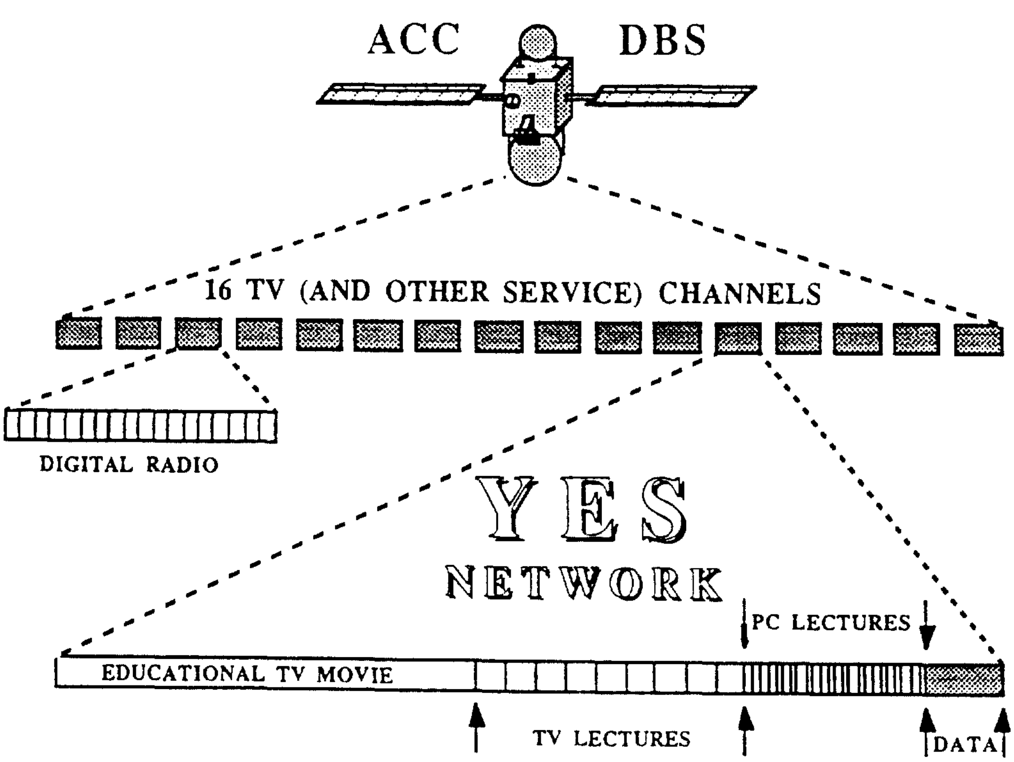
- **Interactive student response to review questions**
- **Reference materials**
- **Reading material**
- **Homework assignments**
- **Supplementary programmed learning**
- **Exams**
- **Classroom teacher planning and preparation**
- **Teacher-elective supplementary subjects**

Delivery of Services

All **YES Network** services will be transmitted via K-band satellite using digital modulation. Dynamic digital multiplexing of services allows extremely efficient use of a single satellite transponder (channel). Each reception point (e.g., school) will have a single receiving antenna and digital receiver. Distribution of services will be either via a central demultiplexer (at lower bit rate) or by direct link (at high bit rate) where each user station processes only the information addressed to it.

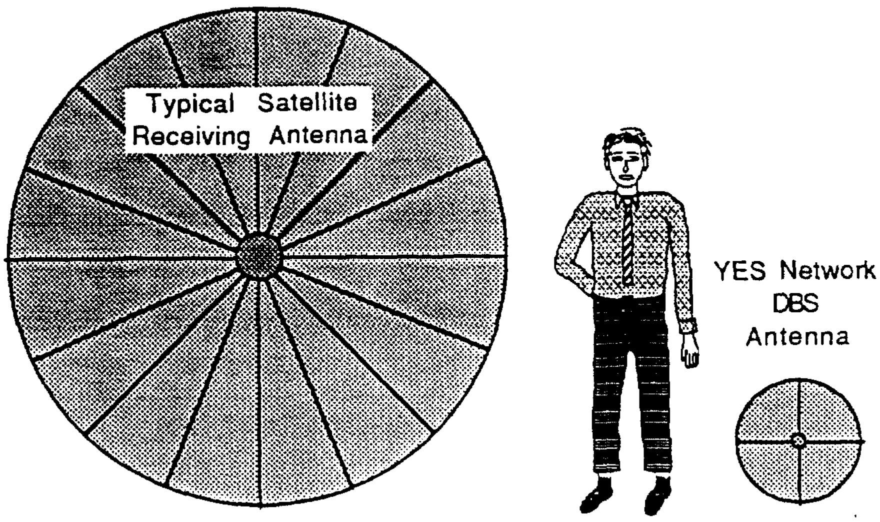
A standard K-band transponder can carry several of these services. The exact number depends upon the mix of services, the transmitted power of the satellite, and the size of the individual receiving antennas. The ultimate incarnation of the **YES Network** is via **DBS** using inexpensive receiving antennas less than two feet in diameter. The same antennas, down-converters, and (possibly) digital receivers will be used as in standard television DBS receivers and will eventually be manufactured in the tens of millions. This is the key to inexpensive school receivers and eventual wide availability of **YES Network** services to individual homes.

The following figure shows how the YES Network will be combined with standard DBS service. The individual service allocations that are shown are only illustrative since the requirement for each actual service is highly dynamic.--



Comparison with Other Systems

The **YES Networks'** advances over today's offerings are staggering. For example, consider the receiving antenna alone. The folloeing figure illustrates the difference: today's 8 foot (or 10') dish antenna vs the **YES Networks'** 2 foot DBS antenna.

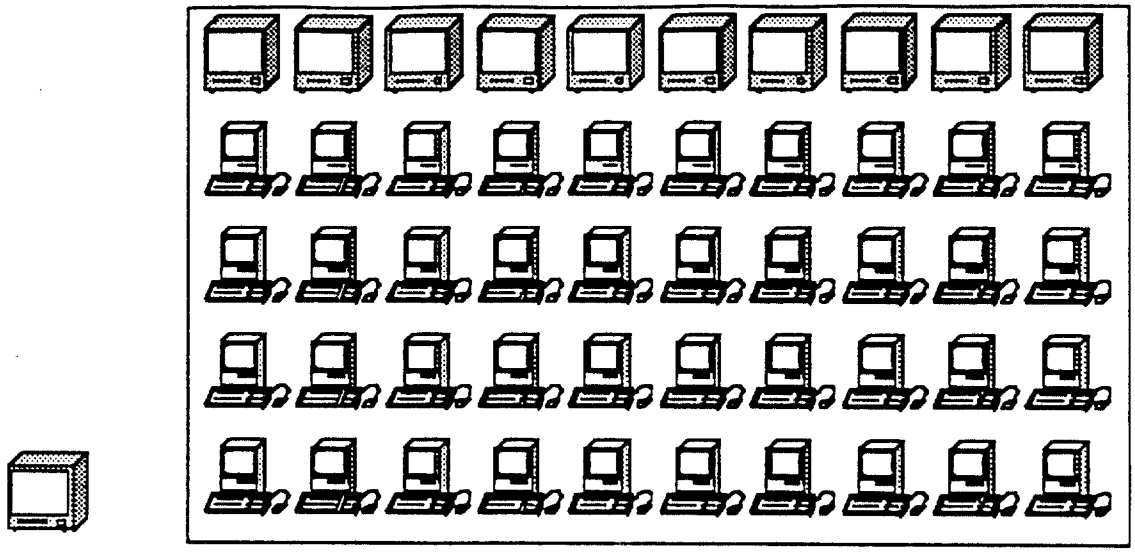


Comparison of Antenna Size

Consider the number of courses that can be offered in a **single** satellite channel. Today, what can be offered is illustrated at the left in the next figure.-- **One TV Course! That's it!** (Maybe two, at best.) What the **YES Networks** can offer simultaneously in a single channel is illustrated on the right side of the same figure-- **ten TV Courses plus 40 Computer Courses, simultaneously**. Now, that's service!!! There are many other contrasts between these systems. Rather than discussing them individually, some comparisons are presented in the table at the end of this section.

There is a great need for digital transmission capability, even in mainly analog systems. For example, the Los Angeles school system has announced its intent to initiate satellite services within the LA system. Officials there have indicated that they would like to use Scientific Atlanta's B-MAC analog encoding system simply because of the inclusion of a relatively low-rate data capability.

The MAC transmission systems (e.g., C-MAC, B-MAC, D2-MAC) were originally developed for commercial DBS transmission. They all use analog time-compressed component-video transmission which results in slightly improved video quality but increases the transmission bandwidth. Therefore, they still require an entire satellite transponder (channel) for each televised course. The only advantage of the MAC systems (over today's NTSC) in this application is the possibility of including some digital transmission capability which can be used for transmitting printed information.



Present vs YES Networks Services

The MAC video transmission system (like NTSC) is inherently rigid in its transmission format. Once you establish it, you're stuck with it (possibly for the next 30 years) as opposed to the all-digital **YES Networks**, which is inherently flexible and can change with the times and the needs for the foreseeable future.

Another system that has been examined by ACE is the NASA ACTS system. ACTS is a multiple-access time-division-multiplexed digital-transmission satellite. (It also includes an analog transmission mode which was not considered for this application.) ACE proposed system modifications to ACTS that would allow it to function as a viable means of serving segments of the Nation's educational needs by transmitting the Computer Course format previously described.

ACE also developed a system design for a less expensive receive-only ACTS terminal. However, ACTS is a spot beam system which is quite limited in its coverage area[1] and its receivers are inherently more complex and will always be considerably more expensive than the **YES Networks'** mass-produced DBS receivers.

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1 Mainly the large metropolitan areas--not the vast, presently under-served areas.

ACTS is basically an experimental satellite which may not spawn commercially viable satellites until at least the late 90's. Each system (ACTS and DBS) has its advantages: ACTS for spot beam local area coverage (locally or remotely generated); the **YES Networks** (DBS) for Nation-wide coverage.

As we have seen in the above discussions, the **YES Networks** is the only known transmission system which can economically provide the large number of diverse educational services which will be required to advance our Nation's educational system in the 1990's and beyond while providing quality education to all, regardless of location or local resources.

	Present Systems	**YES Network**
Recipients of Service	Schools, Businesses	Schools, Businesses, Individual Homes, Hospitals, Libraries
Receiver Antenna Size	8' diam.	2' diam.
Local Zoning for Antenna Dish	Very Restricted (Often Prohibitive)	Not Restricted (Preempted by FCC)
Types of Services	TV Lectures	TV Lectures, Computer Lectures, Written Materials, Teacher Aids, Remedial/Advanced Programmed Learning
Number of Simultaneous Courses in one Sat. Chan.	One (Possibly Two)	15 TV Lectures or 100 Computer Lectures or Combination
Satellite Transmission Cost of One Course	100 % (Reference)	7 % for TV Lecture 1 % for Computer Lecture
Flexibility of Service Offering	None	Complete Flexibility

Service Comparison Table

Conclusion

The concept and potential of the **YES Network** is revolutionary in its implications for the future of education. There is no quicker, more economical or more effective way to bring high quality education to the masses. Quality math, science, adult education and other needed programming will be available to the entire nation. Even low-budget or highly specialized programming can still reach all who so desire.

Clearly, a new age in education is dawning. The marriage of low-cost microcomputer technology and universal coverage DBS satellites presents an unprecedented opportunity for educational broadcast services. For the first time in history, it is possible to economically provide a vast number of innovative educational services to the entire population.

All of the technology necessary to implement the **YES Network** exists today. The immense flexibility of the underlying digital technology and the **YES Network**'s transmission format assure that the system will continually adapt. Future technology and future programming requirements need not be feared. The **YES Network** makes "obsolescence" obsolete.

The concept of the all digital **YES Network** is as basic as that of the development of the radio or the personal computer. Combined with television and personal computers, we now have a chance to make the greatest impact on the quality and availability of education since the invention of the printing press.

The benefit to cost ratio of the **YES Network** is the greatest of any possible investment that we could make. The future strength of our nation depends on our ability to use our educational resources wisely. It is time to apply our available technology toward preparing the next generation.

Additional information on the **YES Network** will be provided upon request.

G. Gordon Apple, PhD
c/o ACE: 213-540-6532
or:
YES Networks, Inc.
3105 South St., NW
Washington, DC 20007

7-26-88

Attachment A

Scenario #1:

Imagine, for the moment, a small-town mid-western school which previously had limited instructional capabilities in math and science. The students come into class, hand the instructor their homework assignments and sit down at their desks.

During the first few minutes, the instructor ask if there were particular difficulties with the homework. In response to each question, the instructor either directly answers the question, or enters it on a computer keyboard. The computer responds either with a direct answer or with information (received at the beginning of the class via the **YES Network**) with which the instructor can formulate an answer. Alternatively, the computer indicates that a video response is available. Selecting the latter, the classroom video screens come alive with a verbal and pictorial explanation. Other questions are handled similarly.

The class then watches a half-hour lecture which was prepared by one of the foremost educators in the nation on that particular subject. During this time, the instructor uses the computer to electronically grade part of the homework and then personally grades those portions that require written responses.

After the lecture, an additional period of questions and answers is handled by the instructor, again with the aid of the computer. The graded homework is returned along with reading material and tomorrow's homework assignment. The latter were printed automatically during the lecture. Additionally, two students are handed study hall assignments on floppy disks with additional remedial programmed learning aids which have been automatically custom-prepared for them based on the homework scores. Another disk is loaned to an exceptionally bright student who wishes to pursue the subject in more depth.

At the end of class, the instructor picks up a printout (or a floppy disk) containing the plan for the next week's classes, teacher preparatory material, and a sample exam which can be customized if desired.

Scenario #2:

A blue-collar worker comes home from a frustrating day at work. It has been difficult, but he has managed somehow to get by all these years without being able to read. He realizes that he is at a dead-end for job advancement but is too embarrassed to enroll in a local adult reading class. He turns on the television to view the listings of tonight's programs on **DBS** (his satellite receiver with a 2' antenna--now as common as VCRs). He watches the videolog which shows a sequence of still-frames ads and has one or two sentence verbal descriptions of each of tonight's programs. He sees (and hears) that the **YES Network** has a beginning class starting tomorrow night on adult reading.

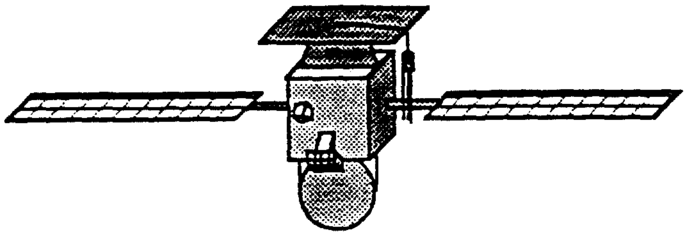
On the following nights he comes home, turns on the TV, and switches on the class. The class consists of still-frame images, reading text, animation, and an instructor's voice. The instructor gradually leads the new student through the basics of reading. Interspersed in the lecture are multiple choice questions, such as identifying the spoken word or sentence from the displayed written choices. He uses his TV remote control to respond. A visible or audible TV response tells him whether his choice is correct or not. At the end of the program, his percentage of first-time-correct selections is displayed, verbalized, and compared with his his previous scores. He is now on the way toward becoming literate, enriching his life, and being a more productive member of society and industry.

Scenario #3:

A college student returns home to her children after working half-day. Her husband is also a student and works the other half of the day. She has already finished her Bachelors degree (mostly through **YES Network** classes) and is now in medical school. Through the YES Network and her home computer she is able to complete most of her classes without having to leave her young children with a baby-sitter.

She is presently taking a course in communicable diseases. This afternoon she especially wants to view a seminar on the latest research results on AIDS treatments. While she is watching the seminar, her computer disk is being down-loaded with a research paper written by the seminar speaker and containing the test results and statistical analysis being discussed during the seminar broadcast.

Later, for general interest, she audits a class on "Music Appreciation." Today's lecture on "the use of vocals within the symphonic form" is interspersed with excerpts from Mahler's 4th and Beethovan's 9th. The sound quality is the same as from her compact disk player.



July 1988

GUTENBERG II:
TOMORROW'S REVOLUTION IN EDUCATIONAL SERVICES TODAY

G. Gordon Apple, PhD
Samuel. A. Covington, PhD

For: The YES* Networks Partnership

(* Your Educational Services)

Partners:

The Wilbur D. Mills Education Service Cooperative
Advanced Communications Engineering, Inc.
The Arkansas State Department of Education
The University of Arkansas at Little Rock
The University of Texas at Arlington
YES Networks, Inc.

Advisors:

The Foundation for Educational Advancement Today -
The University of Hawaii - The University of Miami Center for Interactive Learning -
National School Board Associations' Institute for the Transfer of Technology to Education -
The National Education Association - The American Association of School Administrators -
The Public Service Satellite Consortium - The American Federation of Teachers -
The Center for Rural Education and Small Schools at Kansas State University -
The National Aeronautics and Space Administration

1. ABSTRACT

The **YES Networks Partnership** (YES-P) was formed in order to establish a new and unique type of educational satellite network which will provide services and benefits unparalleled by any other existing or proposed system. The benefit-to-cost ratio of the **YES Networks** is many times greater than that possible with other technologies. TV course lectures, computer course lectures (a new concept in course presentations), instructional materials, informational items, and other teaching and learning aids initially will be distributed via digital-based satellite transmission to schools serving a high concentration of Chapter 1 students.[1]

Digital-based technologies are evolutionary in design, but potentially revolutionary in their impact on conventional education. High-powered satellite signals, received by small antennas (2' in diameter), combined with microcomputers offer perhaps the most impressive technological advance yet introduced into the classroom. Ultimately, the network will reach throughout the United States, serving public and private educational institutions, industries, libraries, individual homes, hospitals and other users with instructional needs.

YES Networks Partnership:

The Wilbur D. Mills Education Service Cooperative
Advanced Communications Engineering, Inc.
The Arkansas State Department of Education
The University of Arkansas at Little Rock
The University of Texas at Arlington
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The Public Service Satellite Consortium - The American Federation of Teachers -
The Center for Rural Education and Small Schools at Kansas State University -
The National Aeronautics and Space Administration

1 Chapter 1 schools serve a high concentration of socially and economically disadvantaged students, particularly those with traditionally poor access to educational opportunities.

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2. Introduction

Only truly innovative means can assure the continued advance of American education to meet the challenges facing students in the 1990's and beyond. Creative solutions will not be developed and implemented overnight, but must be found, tested, and introduced as efficiently and effectively as possible. In the **Your Educational Services** (YES) **Networks'** partnership project, a dramatic new technology is being used as the basis for creating an educational telecommunications network which will yield extraordinary benefits for the students of tomorrow. The technology is available today, and already private companies are moving rapidly to transform broadcast communications with its implementation.

Digital-based satellite communications, cheaper, more efficient and flexible than current technologies in use today, will reduce costs allowing educational institutions to afford this sophisticated means of accessing information and broadcast courses.

The YES **Networks** is a revolutionary new concept in educational satellite broadcasting. It will simultaneously provide an extremely large number of classroom lectures and a multitude of other services, all in a single satellite transponder (channel) where only a single course lecture in now provided by conventional techniques. It is made possible by the rapid advance of digital technology and the imminent availability of **DBS** (Direct Broadcast Satellites). While using new proprietary techniques and designs, the YES **Networks** is well grounded in proven technologies and is therefore low-risk.

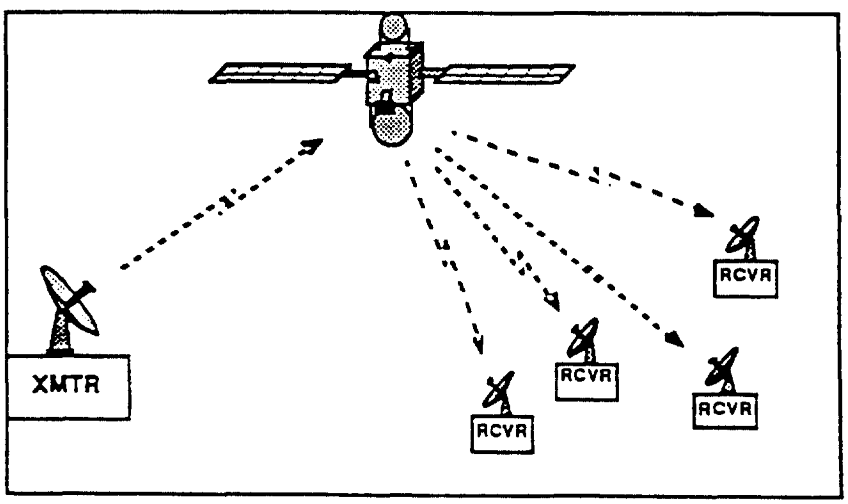

Figure 2-1 Broadcast Satellite System

The envisioned services are part of a satellite broadcast network such as that shown in Figure 2-1. A single up-link ground station provides a multiplexed digital signal which is re-broadcast from the satellite to multiple receive-only ground stations located at individual schools, businesses, or homes. Each ground station may receive any of the broadcast services for which it is authorized.

There are two basic types of services. One is a **TV Course** service which is functionally similar to that being offered today, but is far more transmission efficient, far less expensive, and has the flexibility of including additional services such as printed output. The other is a **Computer Course** service which is even more efficient and less expensive than the TV courses, but can still be displayed on TV monitors or an overhead projector (using a computer adapter). The Computer Course also has vast additional capabilities that cannot be offered by any of today's TV course transmissions. A large number of services can be offered simultaneously by the **YES Networks** within one satellite transponder (channel) as illustrated in Figure 2-2. (Some of the preliminary work has already been described in the proposal[1] and final report[2] for a contract that ACE performed for NASA and the PSSC, in which ACE examined the utility of ACTS[3] for educational broadcasting.)

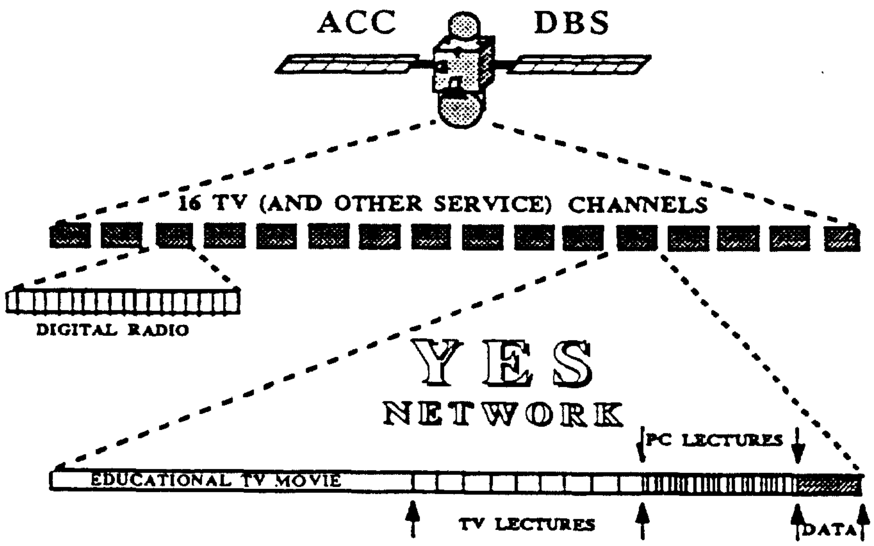

Figure 2-2 DBS Channelization

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1 Advanced Communications Engineering, Inc., *Proposal to the Public Satellite Service Consortium and NASA ACTS Program*, October 21, 1987.

2 Advanced Communications Engineering, Inc., *Final Report: ACTS Educational Broadcasting*, Submitted to the NASA ACTS Program and Public Service Satellite Consortium, April 30, 1988.

3 Advanced Communications Technology Satellite, an experimental digital transmission satellite operating at K_a -band (20-30 GHz).

Costs - Conventional C-band and K_u-Band satellites widely used at present carry transponders (channels) each capable of relaying television signals. Practically, each transponder using the common analog technology for transmission and reception, carries one, or at most two signals as in Canada. Beyond this practical limit, interference becomes a problem because of band-width and power limits. Multiple signals tend to produce mutual interference. With digital technology, such as that proposed in this application, this problem can be avoided to the extent that a single transponder may broadcast many signals simultaneously in a great array of programming. Assuming a very generous estimate, the analog technology could possibly transmit as many as four signals, but even so digital TV equipment could still broadcast fifteen to sixty comparable signals - a factor of about four-to-one (conservatively, or possibly about fifteen-to-one) increased efficiency.

Yet, more significant from a cost perspective is the realization that in order for analog equipment to attempt to match the capabilities of digital receivers, new tuners would have to be developed which could handle four times the reception. This would require undoubtedly difficult multiplexing of signals, and the resulting receivers would be several times more expensive than digital equipment with similar capabilities. Furthermore, digital technology inherently produces clean signals without mutual interference of signals. Thus, both quality and cost advantages argue that for a comparable service (e.g., transmitting course lectures to classrooms), digital equipment would be less expensive for the user as well as the broadcaster (perhaps as much as four-to-one) and produce service of superior quality.

Utility - As dramatic as cost reduction could be with implementation of digital-based satellite telecommunications into the educational system, increased efficiencies are even more impressive. Flexibility and utility are the most significant advantages to the digital technology. The types of programming which can be transmitted, relayed and received through digital technology is virtually unlimited. The ability to compress the transmitted signal permits a single transponder (channel) to carry more than one hundred programs of many types simultaneously. Radio, television, movie, personal computer, data streams, and other types of signals all may be transmitted to a wide variety of users.

Equally important is the fact that the satellite using digital processing will broadcast its signals throughout the entire United States. This feature makes the technology superior to directional satellites (e.g., ACTS) and to microwave transmissions which serve small populations. One satellite transponder can blanket the United States with perhaps one-hundred programs of extraordinary variety. This utility feature of the digital technology makes possible many applications which at present are beyond the reach of the current educational telecommunications systems. Among the more obvious new applications would be:

Improved delivery of such programs as "News Access," a weekly service pioneered by NASA and Turner Broadcasting (CNN) to improve the work of teachers;

Creating new programming such as "Science & Technology Access "or "World Cultural Access";

Satellite educational programming to all of America including Puerto Rico and the Virgin Islands schools;

Relay of educational programming to Department of Defense-operated schools overseas;

Much improved access of rural schools to educational programming;

The United States Department of Education could transmit informational and innovative materials to all schools almost instantly and inexpensively, without the expense of mail service, while avoiding high printing costs;

Better programming to vocational-technical schools, learning libraries, industries, and families and individuals;

In-service training to teachers;

Better service to the migrant student network;

Support of the jobs corps and other Federal programs;

U.S.D.A. market data and information exchange;

Student record tracking of achievement scores and health records;

Senior citizen learning opportunities.

The list is virtually unlimited. The most attractive feature of the digital transmission and receiving equipment is that this technology is completely adaptable to existing satellite transponders (GE "K1" and "K2", Hughes "Galaxy" or RCA "SatCom"), personal computers, and other readily available hardware, and to many popular "off-the-shelf" software programs. No significant conversion problems exist.

Available Resources - The technology is available today. It is cost effective. In addition, the Foundation For Educational Advancement Today (FEAT) has informed the Yes-P that if the utility of digital technology can be demonstrated in the classroom and a user network designed, the Foundation will pledge in return to contribute two transponders and receiving equipment amounting in value to about **$ 400,000,000** to assist the founding and operations of a national educational network

For these reasons -cost, utility, and the availability of extraordinary financial resources- we believe that the opportunity to effect the most dramatic advances in instructional results through the American educational system is at hand. The YES partnership is taking the first steps toward creating a national user network for American education.

3. Project Description[1]

(1) Objectives of the Project

(a) To demonstrate the efficiency and cost-effectiveness of digital-based satellite communications as a new, and revolutionary, technology for applications in mathematics and science instruction specifically in selected Chapter 1 schools in addition to all American Schools;

(b) To foster awareness and understanding of the merits of digital-based satellite communications as a tool for distributing educational materials nationally;

(c) To design the foundation of a national user network as a vehicle for implementing digital-based satellite communications in the traditional educational systems.

The project will construct telecommunications equipment of advanced technologies with revolutionary implications. In addition, the project will also utilize existing, though perhaps slightly modified, mathematics and science course software for classroom demonstrations, primarily on the personal computer but transmitted by satellite. Technical assistance in the use of the equipment and course materials will be provided, and the utility of the technology will be evaluated in Chapter 1 school classrooms.

(2) Meeting the Needs

i. Identification of Needs - The primary need which is addressed is that of **improving the access of Chapter 1 schools to mathematics and science instructional materials** which are at present available only to districts with superior financial resources. In many cases the target Chapter 1 schools are found in the poorest of districts, whether inner-city or rural, and have a student population characterized by a high concentration of educationally deprived students. These academically and educationally disadvantaged students are in need of improved courses of instruction in mathematics and science. The project will demonstrate how, by greatly reducing acquisition and dissemination costs, the introduction of a new technology will expand access of these students to a wider variety of new and improved educational materials and unusual resources, such as exposing them to master teachers from across the country recognized nationally for their instructional excellence.

ii. How the Needs were Identified - As early as the spring of 1987 and pre-dating the Star Schools authorization, discussions were undertaken with a number of national educational

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[1] Additional information on project management is included in Appendix A.
Additional information on personnel is included in Appendix B.

organizations interested in improving access to educational resources, the central issue addressed by the YES-P proposal. These organizations were not limited to the ITTE, AASA, NEA, AFT, ECIA, CRESS, PSSC, UTA, UALR, ASDE, UM and UH.

Shortly after these contacts began, a literature survey was conducted. Reports such as The Governors' 1991 Report on Education, A Time for Results - Task Force on Technology, and the National School Boards' Association, A National Imperative: Education for the 21st Century, make clear the concerns of many educators regarding the need to introduce new methodologies and technologies into education. Conversations with numerous state and federal officials reiterated support of technological applications in the classroom to broaden access to educational resources. Yet, nearly everyone also repeatedly stressed the **high costs associated with the conventional hardware** and available programs, and the **absence of a centralized, unifying network** to schedule programming and coordinate user interests.

Explicitly evident from all of the discussions, correspondence, and "brainstorming" sessions was the consensus that technology as a tool can and should be used to transform the classroom environment and the learning experience in revolutionary ways **if the costs can be reduced.** The realization of this widely-held consensus and the challenges posed by the apparent universal desire to create a user network led directly to formulation of the YES-P project.

iii. How the Need is to be Met - Improving the access of the target Chapter 1 schools to enriched educational resources will be accomplished through the creation of a comprehensive, national network of users who are linked via satellites. However, this is not currently possible through conventional satellite systems due to the high costs of the necessary hardware and software, beyond the reach of most school districts. By applying today's advanced technology, all schools could benefit, and financially disadvantaged schools especially could tap resources currently unavailable. Three elements are required to make the network possible:

(1) An efficient, cost-effective technology for disseminating the instructional and informational materials;
(2) An organization to manage the exchange of ideas and resources;
(3) The financial capacity to enable many users to participate relatively quickly after formation of the network.

The technology is now available through the perfection of digital-based satellite communications. This versatile technology is capable of disseminating a full range of instructional and informational programming at significantly reduced costs. Eventually, all schools would find access to the system to be easily within financial reach. This is especially true in light of the commitment of the Foundation for Educational Advancement Today (FEAT) to contribute two transponders (channels) to a national educational network, and place receiving equipment in each school.

Once such a system is created and implemented through a network of users, there would be no reason for any school to be deprived of access to an extraordinary inventory of educational programming far in excess of that now available only to the wealthier districts. This great advance in educational access would be possible not only by introducing new hardware, but also through the pooling of resources in a user network.

iv. Public Benefit - The public benefits to be derived from meeting the need for improved access to instructional and informational materials are legion. One might draw a sharp contrast between the access to educational resources enjoyed by most schools today and that potentially afforded by an effectively administered digital-based satellite communications network with the increased access to information created by the **Gutenburg press** revolution of the fifteenth century. With Gutenburg's invention, costs fell and the dissemination of ideas exploded. Learning was available to a vastly expanded audience. Similarly today, although technology cannot replace the human resource of the teacher in the classroom, it can greatly extend and expand the teacher's inventory of educational materials and effectiveness with students. The demonstration of the feasibility of using digital-based communications in education and the lower costs associated with such a system will be the most persuasive argument for creating a network of users founded in public and private schools. This is the major objective of the proposed project.

(3) Other Information

i. Programming

Program production is presently not a major focus of the YES-P project. However, existing mathematics and physics course materials will be acquired for demonstrations of the feasibility and utility of digital technology in Chapter 1 schools. The design of the user network will include descriptions of the types of programming which are most suitable to the medium of digital-based satellite communications. These are expected to represent instructional areas where deficiencies in the current educational system are readily apparent.

ii. Survey of Needs

Discussions with state educational institutions concluded that prime beneficiaries of the project should be school districts with limited resources and extensive needs. In planning the YES-P project application, the partners sought to characterize those **students who were most in need** of improved access to educational resources, and insure that they were addressed in the project. The ASDE has undertaken a multi-dimensional assessment of districts in the state to reveal those areas most in need. It was determined that most of the test demonstrations conducted in classrooms would be performed in schools with a **high percentage of Chapter 1 students.**

Basing the selection of the demonstration schools on data supplied by the ASDE assures that in the short term the technology used in the project benefits most those students with poorest access to mathematics and science courses. The specific schools to be selected will be recommended by the ASDE Chapter 1 Office Director, Mr. Bob Kerr. Project participants will be selected without regard to race, color, national origin, gender, age or handicapping condition. However, the ultimate aim of the project is to create a national user network providing inexpensive access to all.

iii.. Teacher Training

Teacher training will be conducted on two levels. First, those teachers who will participate in the classroom demonstration will receive **specialized training** for the purposes of the test. The teacher training will be carefully structured to assess both the level of instruction necessary to equip the teachers to use advanced technology in a realistic setting, and the effectiveness with which instructions assimilated by the teachers are communicated to their students. Specifically, of major interest is the level of exposure of the teachers to advanced hardware prior to the test, their receptivity to using new technology in the classroom, and their ability to create a positive learning experience for Chapter 1 students with advanced technology.

Quantitative and qualitative methods will be utilized in these assessments, and a **teachers guide** to using advanced technology with disadvantaged students will be produced. Although this guide will have been developed through the use of a specialized digital-based technology, it will be **adaptable to other more conventional applications** of technology in the classroom. Second, opportunities for **continuing teacher training** will result from the contribution of the test equipment to participating institutions after completion of the demonstrations. The digital transmission and receiving equipment will be contributed to the UTA Engineering and Instructional Television Program for engineering and television **teaching and research.**

4. Technical Aspects of the Project

The types of services to be offered are described first, followed by a comparison with existing services, a discussion of installation and training, and the proposed plan to implement the system and the equipment to be provided.

(1) TV Course

All television broadcasting systems today (including satellites) use analog transmission. In the western world the predominant system is known as NTSC[1], a standard that was established about 40 years ago. The analog system has served us well for all types of programming from stationary test patterns (for adjusting the analog TV sets) to the violently-changing images of a special-effects ladened movie. However, it has long been recognized that this system is extremely inefficient in transmitting images in which change is the exception rather than the rule (e.g., business conferences and classroom lectures). For this reason, much work has been done over the last 20 years in improving the efficiency of transmitting such images.

Because the human visual system requires the continual presence of an image, any efficient transmission system must contain storage and processing of the image in a manner that is transparent to the user. From the beginning, these techniques have concentrated on digital technology due to its superior storage and processing qualities, although in the early years it was very expensive. Even so, commercial systems have been available for over 10 years for high quality transmission of video conferences at bit rates of 1.5 to 3 Mb/s (mostly over expensive, leased telephone digital carrier lines). In more recent years, systems have been developed that operate at rates as low as 64 kb/s, although their video quality leaves much to be desired. In all cases, the cost of digital technology has now come down drastically and will continue to do so.

Video quality adequate for some conferencing and classroom lectures can be attained at a bit rate of 384 kb/s. However, for the YES Networks TV Course system, we have chosen a conservative and well proven basic rate of 1.5 Mb/s . Actually, this will be superior to a normal 3 Mb/s system because our dynamic multiplexing system assigns additional capacity (from a reserve pool) when needed. Our broadcasting system will provide a usable rate of 26 Mb/s in each transponder. Therefore, allowing for the reserve pool, about 15 TV Course channels can be simultaneously accommodated.

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1 National Television Standards Committee

The system is even more flexible. Our proprietary multiplexing technique allows a continuous spectrum of bit rates to be accommodated. Somewhat depending on the type of programming, the service originator can simply lease the bit rate that suits his needs and budget. All required operating parameters for this choice are automatically down-loaded through the satellite to the user receivers.

Because this is a broadcast system (i.e., one source, many destinations), the TV compression system is optimized to provide most of the necessary complexity and expense in the few encoders (source) and minimize complexity and cost of the many decoders (service recipients). One decoder is needed for each received course. However, the reconstructed standard NTSC TV signal can be distributed to any number of TV monitors (or receivers) within a school.

(2) Computer Course

The means of presenting visual materials in classrooms and business is rapidly undergoing a revolution of its own. It began with developing vu-graphs for an overhead projector by drawing and typing them on a personal computer. Then they are printed on paper (for transfer to acetate), or in some processes, printed directly to a transparency sheet.

Only recently has it been realized that the "printed medium" stage is not necessary except for handouts and that images can be output directly from the personal computer to a TV monitor for small groups or to a TV projector for larger audiences. The latest trend is to use a liquid crystal plate placed directly on an overhead projector. This results in a crisp, bright image with similar quality to that of a printed transparency and can easily be viewed from anywhere in a lecture hall. Numerous software packages now are readily available (e.g., Microsoft PowerPoint, Cricket Presents) for generating vu-graph images and then automatically sequencing them on the computer screen for the actual presentation.

Sophisticated animation programs (e.g., MacroMind's VideoWorks II, Apple's Hypercard) also are economically available. They include a multitude of special effects which keep the presentation visually stimulating and highly effective.

Another recent trend is the use of personal computers for the capture, storage and manipulation of a vast amount of external imagery. This has been made possible by the increasing availability of inexpensive RAM memory chips, large capacity discs, graphics processor chips, image scanners, TV frame grabbers, and generally more powerful personal computers. Recent advances have also been announced for recordable CDs (Compact Discs) and DAT (Digital Audio Tape), both of which provide a quantum leap in available computer storage capacity at a fraction of the previous cost. It should be noted that, in a broadcast system, most of these items are only necessary at the program source. The service recipient requires only a relatively inexpensive personal computer, some of which are now in the \$500-\$1000 range with prices continually declining.

Sketch pads are also being used by instructors as an electronic blackboard and for pointing to or annotating items on the screen showing Vu-graphs.

High quality voice transmission will be provided by using 64 kb/s digital encoding. While this is the same bit rate used for the past 30 years by telephone digital carrier systems, the quality will be vastly superior to today's telephone channels and will sound completely natural. This system will use ADPCM (Adaptive Differential PCM) encoding (7 kHz bandwidth) instead of the older PCM (Pulse Code Modulation) encoding (≈ 3 kHz bandwidth) still used by the telephone system.

An illustration of this type of system is shown in Figure 4-1. Once prepared on the computer, the course could be presented entirely in real-time or by playback of a recording on CD, DAT, or F1-format VCR tape (standard tape, used today for digital high-quality music recording).

The simple addition of an inexpensive printer at the receiver will allow simultaneous transmission of printed materials for use by the class or the classroom teacher (or assistant). It should also be noted that only a single computer is necessary (although more might be desirable for other uses described below). The reconstructed signal can be distributed throughout the school to TV monitors or use other display methods described previously.

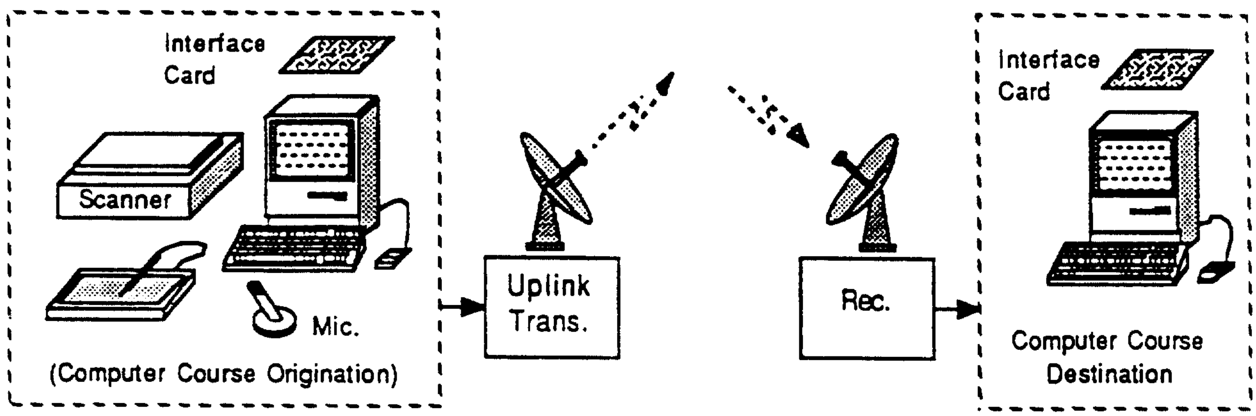

Figure 4-1 Computer Course System

Because the receiving terminal inherently uses a personal computer, it is easy to see that a vast number of additional teacher aids and learning aids can also be transmitted to the computer. For example, examinations can be downloaded to the computer and still allow the local teacher to select questions or customize the exam. Grading can also be highly automated and impartial. Programmed learning can be provided for off-line remedial or advanced study. This is where additional computers would be useful. (They are not required to be connected to this system. Floppy discs will be adequate.)

The nominal basic bit rate for the computer course service has been selected to be a generous 256 kb/s with the capability of additional dynamically-assigned burst transmission when needed. This will allow **over 100 computer courses** to be simultaneously transmitted in one satellite channel if no other (e.g., TV) services are transmitted. A more realistic mix is **10 TV Courses** plus **40 Computer Courses** being offered simultaneously.

(3) **Comparison**

The **YES Networks'** advances over today's offerings are staggering. For example, consider the receiving antenna alone. Figure 4-2 illustrates the difference: today's 8 foot (or 10') dish antenna vs the **YES Networks'** 2 foot DBS antenna.

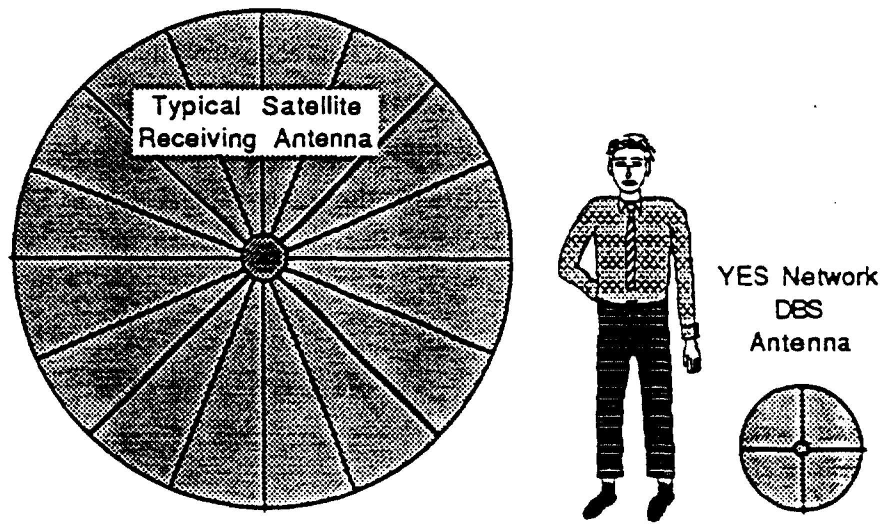

Figure 4-2 Comparison of Antenna Size

Consider the number of courses that can be offered in a **single** satellite channel. Today, what can be offered is illustrated at the left in Figure 4-3.-- **One TV Course! That's it!** (Maybe two, at best.) What the **YES Networks** can offer simultaneously in a single channel is illustrated on the right side of Figure 4-3. **Now, that's service!!!**

There are many other contrasts between these systems. Rather than discussing them individually, some comparisons are presented in Figure 4-4.